



Steve Johnson is director of a division at INL's Space & Security Power Systems Facility, where heat and power sources for deep space missions are fueled and flight tested.

INL scientist works on one-of-a-kind projects at work, home

By Brianna McNall, *INL Nuclear Science & Technology Intern*

The countdown has started on the Mars Scientific Laboratory mission. Originally set to launch in 2009, the mission was delayed to 2011. Now all the pieces of the launch are coming together — including the new rover's power source, the Multi-Mission Radioisotope Thermoelectric Generator (MMRTG).

Steve Johnson, director of the Space Nuclear Systems and Technology Division at Idaho National Laboratory, oversaw the fueling and testing of both the MMRTG and its predecessor, the Radioisotope Thermoelectric Generator (RTG) for the 2006 Pluto New Horizons mission. Both RTGs were assembled at the Space & Security Power Systems Facility (SSPSF) at the INL site.

RTGs use radioisotope decay to generate heat and electricity for space missions. They can supply low amounts of electric power for well over a decade. The United States military first launched a satellite powered by an RTG in 1961. Since then, many other missions have been powered with RTGs. Although the concept is not a new idea, it is a constantly developing one.

As new applications for RTGs emerge, the technology has to evolve. The RTG for the Pluto New Horizons mission needed to work only in the cold vacuum of space. The Mars mission RTG, however, needs to generate power both in space and on a planetary surface, so it required a new design. Each time an RTG is designed and assembled, it has to undergo rigorous qualification testing.



Technicians fuel the power sources by controlling manipulators inside the Space & Security Power Systems facility's Inert Atmosphere Assembly Chamber.



Pu-238 heat sources are assembled into their graphite encapsulation in the Space & Security Power Systems Facility's Module Assembly Glovebox.

When the space missions are launched, these power systems will be subjected to heavy vibrations and dramatic temperature changes. They have to be able to withstand the difficulties of the launch, and operate for many years afterward without any chance of maintenance or refueling. At SSPSF, each RTG has to pass acceptance testing — first being shaken up on the facility's vibration table, and then checked for steady power rates and magnetic field generation that could interfere with instruments.

Since the facility was built in 2003-2004, both the Mars MMRTG and the New Horizons RTG have been fueled and flight tested. Now the MMRTG is sitting in air-conditioned storage to siphon off the heat it is producing; you can't turn off the decay of a radioisotope. The MMRTG has been waiting for a while now, since it was ready for the 2009 launch window. For anyone who has been counting, that's two projects in just less than seven years.

"You need to very much have a patient outlook in life," Johnson said.

Not that Johnson doesn't keep busy. While waiting for the Mars mission to launch, the Space Nuclear team has already started work on the 2015 Advanced Stirling Radioisotope Generator (ASRG). On top of that, Johnson has another hobby to help keep him occupied.

"Outside of work, my real passion is woodworking," Johnson said.

Johnson carves wood burls, abnormal tree growths that are usually the result of some environmental stress.

Because of their odd shape and fast growing speeds, these burls often have interesting and beautiful grain patterns inside, making them ideal for artists to work with. They grow on a limited number of trees, but there is enough variety for some good contrast, from almost-white birds-eye maple to dark black walnut.

Larger burls can be cut and sanded to make tables or benches, while smaller pieces can be made into bowls, utensils or cribbage boards.

"You can make one of those in four to six hours," he said, gesturing to the cribbage board on one of his burl tables. "No problem at all. You just

sand it down, line up the drill press and go."

Most of the cribbage boards he makes are given away as gifts. And he admits that he probably won't be making many more tables for their home anymore either — they're running out of room.

He won't have too much time to work on his woodcarving soon, since training is beginning for the Mars launch this fall. In September, some of the Space Nuclear team will head down to Pasadena to train at the Jet Propulsion Lab facilities for the fall 2011 launch. The following June, the team will haul the MMRTG down to Florida, and will take shifts through the launch window, sometime between Thanksgiving and Christmas.

"We're present at the launch because if the mission is scrubbed, we have to remove the power supply," Johnson said.

Of course, it's doubtful that any of his team will be complaining too much when they have to leave Idaho Falls to spend time in Florida next November.

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The odd shape and fast growing speed of wood burls create interesting grain patterns for artists such as Johnson to work with.